MECHANICS.

Conducted by B. F. FINKEL, Kidder, Mo. All contributions to this department should be sent to him.

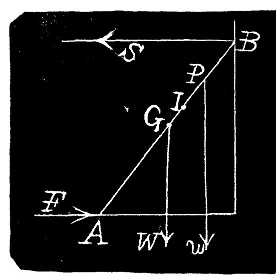
SOLUTIONS TO PROBLEMS.

9. Proposed by CHARLES E. MYERS, Canton, Ohio.

A ladder inclined at an angle of 60° to the horizon rests with one end on a *rough* pavement and the other against a *smooth* vertical wall. If the coefficient of friction between the foot of the ladder and the pavement is $\frac{1}{6}\sqrt{3}$, to what height can a man ascend before the ladder will begin to slip?

Solution by B. F. FINKEL, Professor of Mathematics, Physics, and Astronomy, Kidder Institute, Kidder, Missouri.

Let AB be the ladder, length $2l$; θ its inclination to the horizon, W its weight and G its center of gravity; $AP=x$, the distance the man ascends and w his weight; I, the center of gravity of the man and ladder; $F=\mu$, the coefficient of friction; and S and R the normal resistance at A and B, respectively.



Then we have $S-F=0\ldots.(1)$ and, $W+w-R=0\ldots.(2)$. Taking moments about I, we have $W.GI=w.PI$, or $W.GI-w.\,PI=0\ldots.(3)$. But $GI+PI=x-\frac{1}{2}l$. Hence, from (3), $GI=\frac{w}{W+w}(x-\frac{1}{2}l)$. Taking moments about A, $(W+w).AI=AB.R(\cos\theta-\mu\sin\theta)$ or $(W+w)\left[\frac{w}{W+w}(x-\frac{1}{2}l)+\frac{1}{2}l\right]\cos\theta=2lR(\cos\theta-\mu\sin\theta)\ldots.(4)$. (2) and (4) give $2l(W+w)(\cos\theta-\mu\sin\theta)=(Wl+wx)\cos\theta$, whence

$$x=\frac{2l(W+w)(1-\mu\tan\theta)-Wl}{w}.$$ But $\mu=\frac{1}{6}\sqrt{3}$ and $\tan\theta=\sqrt{3}$.

$\therefore AP=x=l$. Hence the man can ascend to the middle point of the ladder.

[Note.—This problem and its solution was selected for publication in the Aug. No. But it was lost in the office of the publishers and thus we are unable to credit our contributors for their solutions to it. Ed.]

10. Proposed by G. B. M. ZERR, A. M., Principal of High School, Staunton Virginia.

A paraboloid floats in a liquid which fills a fixed paraboloid shell; both the paraboloid and the shell have their axis vertical and their vertices downward; the latus rectum of the paraboloid and shell are equal, and the axis of the shell is m times that of the paraboloid. If the paraboloid be pressed down until its vertex reaches the vertex of the shell, so that some of the liquid overflows, and then released, it is found that the paraboloid rises until it is just wholly out of the liquid, and then begins to fall. Prove that (1) the densities of the paraboloid and liquid are in the ratio.

$2[m^2+m+1=(m+1(\sqrt{m^2}-1)]:3\sqrt{(m+1)\div(m-1)}$, the free surface of the liquid being supposed to remain horizontal throughout the motion; and (2)